Energy Efficiency Programs:
Doing Good for Both Goose & Gander

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Introduction

This paper is about designing good energy efficiency programs – programs that will be good for both the participating customers (the "gooses" if you like) and the utility and its nonparticipating customers (the "ganders").

Our contention is that the very same tools and tests that are used to evaluate the cost-effectiveness of these programs can and should be used when designing them. Altering the program design can make a program more (less) attractive from the participant's perspective and less (more) attractive from the utility and non-participants' perspectives. Utilities should experiment with alternative designs and attempt to find a balance that will benefit both participants and non-participants. Utilities should avoid discarding or dismissing proposed programs too quickly without investigating the cost-benefit consequences of alternative program designs.

Energy Efficiency Programs

An energy efficiency program is one that delivers the same or greater benefits to participants for less total energy use. A participant will not be impressed with this result unless their total energy bill is also lower.

Energy efficiency programs come in many flavors. Some of those that come to mind are programs to:

- Replace inefficient things with more efficient things, e.g.,
  Lower SEER with higher SEER air conditioners & heat pumps
  Less efficient with more efficient water heaters
  Less efficient with more efficient furnaces
- Reduce energy waste, e.g.,
  Tighten up & insulate
  Wrap ducts and water heaters
  Thermal pane windows

Energy efficiency programs may reduce the amount of energy required to deliver the same time-pattern of benefits to consumers. For example, a program to induce the adoption of higher efficiency air conditioners will not alter the time-pattern of adopters' demands for cool air but it will reduce the energy required to deliver it.

Some programs provide participants with incentives to move their energy consumption away from those times when it is very costly to supply it and toward those times when it is less costly. For example, time-of-use rates generally provide these incentives. Another more politically charged example is a program to replace gas furnaces with high-efficiency heat pumps. Participants wanting heat would fuel that need with "off peak" electricity rather than "on peak" natural gas. The total energy bill and, perhaps, the total energy requirement for a given amount of heat may well decline. These programs position themselves as being more *economically* efficient but not necessarily more *energy* efficient.

A simple way to define and think of energy-efficiency programs is to think of them as programs designed to discourage the wasteful use of energy. It is possible for an energy efficiency program to result in an increase in the amount of electricity or natural gas used. It is possible for an energy-efficiency program to result in larger peak periods demands for electricity or natural gas. Decreasing the waste of energy does not necessarily mean using less of any particular type of energy. In fact, if some technological advance permitted the delivery of twice the energy for half the current cost, more energy would almost certainly be used and ought to be.

Conservation Programs

Conservation programs are programs designed to reduce energy consumption. They are not energy efficiency programs. They are meant to encourage behavioral or lifestyle changes that will result in the use of less energy. The thinking is if people use less energy, less will need to be supplied and therefore less of the negative side effects of supplying energy will be felt (e.g., less pollution, less silicosis, less chance of nuclear accidents).

Energy is used to produce things that people want – things like heat, cool air, hot water, and cooked food. Reducing energy consumption translates into sacrificing some of those things that energy makes possible. If the value of these sacrifices is greater than the cost savings plus the economic value of the improved environment then economic efficiency has degenerated and energy-efficiency has not been affected at all. Energy efficiency programs often result in the conservation of energy but not always.

Peak Reduction Programs

Peak-load reduction programs are programs designed to (duh!) reduce peak load. People will voluntarily participate in these programs when they perceive the benefits of doing so exceed the benefits they receive from the energy they would otherwise have consumed at the peak. Energy efficiency is unaffected but economic efficiency may well be advanced.

What programs to offer?

The best way to reduce waste and encourage the economically efficient use of our energy resources is to subject all proposals for energy efficiency, conservation, or peak reduction programs to a common set of measures. These measures are designed to calculate the monetary value of all the benefits and costs of these programs. Utilities should then pursue only those programs that pass muster and continue to offer programs only if they remain cost-beneficial.

Cost Benefit Measures and Program Design

A useful way to discuss the costs and benefits of utility-sponsored energy efficiency programs, peak-load reduction programs, or marketing programs is to first fix the perspective. The relevant perspectives are those of the subscribing customers, the sponsoring utility, and the non-participating customers.

A standard suite of benefit-cost "tests" has evolved over the years. These tests are used individually and jointly to help guide program decisions by utilities across the country. The tests are the Participant, Ratepayer Impact Measure (RIM), and Total Resource Cost (TRC). The last test, the TRC, combines perspectives to measure a program's value more from a societal perspective and less from any particular perspective. Programs that prove cost-beneficial on both the Participant and RIM tests will usually prove cost-beneficial from society's perspective also. Consequently, this paper focuses exclusively on the Participant Test and Ratepayer Impact Measure.

The value of a program from the perspective of the:

Program Subscriber	is best measured with the Participant Test
Non-participant	is best measured with the RIM Test
Utility	is best measured with the RIM Test

From the sponsoring utility's viewpoint, the higher the score on the Participant Test the easier the program will be to market and expected participation will be higher and earlier.

A high score on the RIM Test will mean lower expected prices for all the utility's customers (participants and non-participants) over the planned term of the program.

Good program design will try to maximize the Participant Test score while insuring that those customers that do not participate in the program pay no more than they would have paid in the absence of the program.

Program design will influence the test results. A program that a utility offers "free" to participants may be very attractive from a participant's viewpoint but fail to pass RIM. By changing the program design and charging a participation fee, the Participant Test score goes down and the RIM test score will rise. Those who wonder whether something is or is not cost beneficial often overlook this trade off and either too readily accept a program design or too quickly reject the program altogether.

Before one can understand the economics of a program from the various perspectives, a good understanding of the types of costs and benefits that each test captures, is necessary. While the results of each test can be expressed in a variety of ways, in all cases it will be necessary to calculate the net present value of the program's impacts over the lifecycle of those impacts or over the program's expected life.

The Participant Test

The Participant Test measures the quantifiable benefits and costs to customers choosing to participate in a program. Since many customers do not base their decision to participate in a program entirely on quantifiable variables, this test is not a complete measure of the benefits and costs of a program to participating customers. This caveat may be especially applicable to energy efficiency, peak load reduction, and conservation programs as will be explained below.

The following table shows the categories of benefits and costs that are included in the calculation of the Participant Test.

The Participant Test

Benefits	**Bill Reduction** **Incentives** **Avoided Appliance Costs**
Costs	**Program Participation Fees** **Required Equipment Costs** **Customer Paid O&M**

The benefits of program participation include any reductions in the subscriber's electric/energy bills. These reductions are those that attend a participant's taking advantage of the program. If it is a program designed to increase the energy efficiency of end uses, then a reduction in energy consumption can be expected. Other things equal, participants' energy bills will go down. For the participating subscribers, this is a good thing.

The benefits also include any incentives that are paid to participants as an inducement to participate. This incentive may include eligibility for a particular rate where the rate design grants a participant a lower bill.

If the program extends the life of existing appliances, there will be some avoidance of incremental appliance investment. If the program encourages electric water heater or heat pump sales, the differential life-cycle costs of the alternative technologies is a monetary benefit that flows to the consumer and should be counted.

The costs to participate in a program from the participating customer's perspective include any recurring or non-recurring program-specific costs such as participation charges, any costs for facilitating equipment (including operation and maintenance costs) that subscribers are expected to bear.

The Participant Test involves placing the benefits and costs along a time line according to when a participant may expect to incur them and then calculating a discounted net present value of this stream of benefits and costs. Once this calculation is made, the result can be expressed in a variety of ways.

- Net present value for the total program
- Net present value per average participant
- A benefit-cost ratio
- A discounted payback

The discounted payback is the amount of time it takes for the cumulative discounted benefits to equal the cumulative discounted costs. The shorter the discounted payback, the more attractive or beneficial the program is to participants. The other representations are self-explanatory.

Participant Test Issues for Energy Efficiency Programs

Programs that are designed to encourage energy efficiency may alter the relative life-cycle costs of fuel competitive end-use technologies. This change can induce what is commonly known as "fuel-switching behavior". Thus, for some customers, their expenditures for one fuel (e.g., electricity) may increase but their total energy bill may go down. This does not present a problem for economic efficiency so long as the choice of end-use technology is not distorted by offering the energy-efficiency program. Nevertheless, the potential fuel switching behavior should be carefully considered when performing this test.

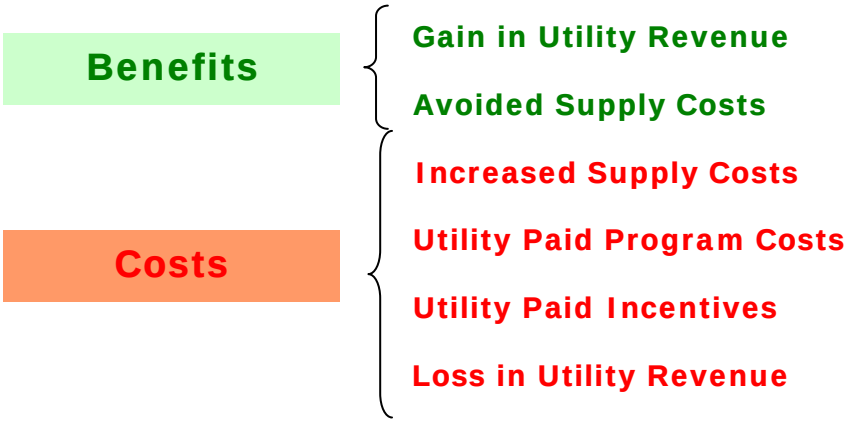
Energy efficiency programs may offer customers an opportunity to help conserve and contribute to having continued access to reliable energy supply. Customers are known to value these things but quantifying that valuation is still subjective.

Energy efficiency programs will, other things equal, lower participants' energy bills. This effectively results in an increase in participants' disposable income. Eighty per cent or more of the savings will be spent on other goods and services. This will spur the economy. The newly demanded goods and services will have some energy input required for their production. This increase in energy demand will somewhat dampen the decreases that attended the increase in energy-efficiency. This participant-driven, second-order effect is often unaccounted for by the Total Resource Cost test or other tests.

The Ratepayer Impact Measure Test

The Ratepayer Impact Measure (RIM) test quantitatively estimates what happens to customers' bills or rates because of changes in the sponsoring utility's revenues and costs that are caused by the program. If the changes in the utility's revenues and costs caused by the program's implementation result in lower rates than otherwise, the program will pass the RIM test.

The RIM Test



The benefits calculated in the RIM test are the savings from avoided supply costs and any increase in revenue. Avoided supply costs include the reduction in transmission, distribution, and generation capacity costs for periods when load has been reduced.

The costs for this test are the programmatic costs incurred by the utility, incentives paid to participants, decreased revenues for those periods when prices are lower than they would otherwise have been, and any increased supply cost associated with those periods when load increased. The program costs include initial and recurring costs, such as the cost of equipment, operation and maintenance, installation, program administration, marketing, customer dropout and equipment removal.

The results of this test can be presented in several ways. The primary expressions of RIM test results are the lifecycle revenue impact and the net present value. Other expressions of results are typically of secondary interest.

The lifecycle revenue impact is the one-time change in rates or the bill change over the life of the program that is needed to align total revenue with total cost. The rate change is presumed effective in the first year of the program. This avoids confusing programmatic impacts with expected future changes in other costs.

The net present value of RIM benefits and costs gives the discounted net benefit of the program from the perspective of rate levels over some specified period of analysis.

The key benefit of the RIM test for an energy efficiency program is it is the only test that reflects any revenue shifting between participants and non-participants as well as all other costs and benefits associated with the program.

RIM results are sensitive to differences between projections of marginal costs and long-term rate projections. These projections have a high degree of inherent uncertainty. RIM results may also vary significantly with financing assumptions. Sensitivity analyses of various types are needed to quantify this risk and these analyses are usually difficult and costly to implement.

Conclusion

Program participants, program sponsors, non-participating customers, society, and special-interest groups all have perspectives. They are not all the same. A program that serves the special interests of Green Peace or the National Association of Manufacturers may not serve the interests of program participants, non-participating customers, or the utility sponsoring the program.

The challenge for those of us advocating energy-efficiency programs is to find programs that serve the interests of society through a no losers approach – find and promote programs that are good for both the geese and the ganders!